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## RCA Player Diode and Transistor Reference Guide

The tables further down this page cross-reference RCA CED player diodes and transistors to their industry equivalent, NTE, TCE, ECG, Radio Shack, and Jameco counterparts. NTE Electronics is an electronic distributor that provides a wide range of IC's corresponding to specific manufacturer's part numbers. Most of the diodes and transistors in CED players are common parts in the electronics industry, and some can be obtained for as little as 4 cents each from Jameco Electronics.

RCA used a lot of different part numbers for these parts that were only slightly different from one another. The purpose for this was to achieve overall manufacturing specifications within a given tolerance range. But for purposes of repair, where only a single part is being replaced, a generic industry diode or transistor of the same type and package style as the original part will probably work just fine. This is why so many of the different RCA part numbers in the tables cross reference to the same industry standard part.

For general purpose diodes, there are only two replacement types required, the 1N4009 in the DO-35 package and the 1N4007 in the slightly larger DO-41 package. With light emitting diodes just about any LED in the 5mm T1.75 package can be substituted, so different colors and even blinking LEDs can be used. But varactor and zener diodes need to closely match the original part, so the capacitance effect or reference voltage of the replacement part is within specification. With general purpose transistors, there are again two primary industry standard substitutions, the PN2222 for most of the TO-92 package NPN transistors and the PN2907 for the corresponding PNP bipolar type. These two transistors are by far the most common, being used a number of times in any given player, while the more exotic transistors, like the programmable unijunction and hall effect latch types are used only once or twice.

The part numbers with an "X" in the replacement column have no cross reference data available period, while those marked N/A are listed in cross reference guides, but that distributor doesn't supply the part. Part numbers with linked text will open a PDF data sheet when clicked on.

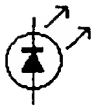
## Schematic Symbols and Functions:



### General Purpose Diode

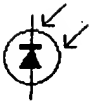
A diode can be thought of as a valve that permits the flow of electrical current in one direction but not the other. This characteristic is used to perform rectification or the conversion of AC current to DC by clipping off the negative portion of a sinusoidal

AC waveform. The diode terminals are the anode and the cathode, and the "arrow" inside the diode symbol points toward the cathode, indicating current flows in that direction when the diode is forward biased and conducting current.



### Light Emitting Diode (LED)

The general purpose silicon diode above emits excess energy in the form of heat when conducting current. If a different semiconductor material such as gallium arsenide phosphide is used, the excess energy can be released at a lower wavelength visible to the human eye. This is the composition of the LED, which with a translucent housing is used as a long-lived indicator light in CED players and as an infrared transmitter in CED remotes. An LED (in conjunction with a phototransistor) is also present in the OS1 Photo Coupler assembly used in some CED players to approximate elapsed time when the player is in rapid access search mode.



### Photo Diode

A photodiode has the semiconductor area exposed to external light, which it is sensitive to. Photodiodes are operated in reverse bias, which means the diode is not conducting current in the conventional sense, but there is always a very small reverse-leakage current present. This reverse current is at a minimum in total darkness and increases as more light strikes the semiconductor. Photodiodes sensitive to infrared light are used as the signal receivers in CED players with IR remotes.



### Schottky Diode

Schottky diodes use a junction of semiconductor and metal, rather than the junction of "N" and "P" semiconductor material used in the general purpose diode. This metal-to-semiconductor junction allows Schottky diodes to rectify very high frequencies. They are used in the RF output (channel 3/4) and RF input (antenna) sections of CED players.

### Varactor Diode



A varactor diode can actually be considered a voltage-variable capacitor, thus accounting for the capacitor symbol to the left of the diode symbol, which is the way RCA illustrated varactors on their schematic diagrams. Varactors were commonly used in old-fashioned analog tuning circuits. In CED players they are used in the pickup arm resonator, in the input section to the RF modulator, and in the tuning section of the OSD processor.

### Zener Diode



Zener diodes are specified by an exact breakdown voltage and are used to regulate the voltage at a circuit node to that precise value. In CED players they appear in power supply regulation and in power regulation of the comb filter circuit. Two CED zeners have voltages of 2.85V and 5.8V which are not industry standard, but this does not mean industry standard replacements can't be used. Zeners typically have a tolerance of 5%, so a supply of 2.8V zeners could be measured until a 2.85V unit is found, and the same could also be done with a supply of 6.0V zeners.

### NPN Transistor

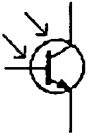


Bipolar junction transistors perform the function of amplification where a small varying voltage or current applied to the base (the lead on the left side of the symbol) is proportionately replicated by a much larger voltage or current between the collector and emitter leads. Bipolar junction refers to sandwich construction of the semiconductor, where a wedge of "P" material is placed between two wedges of "N" material. In this NPN construction a small base current controls the larger current flowing from collector to emitter (the lead with the arrow).

### PNP Transistor



Similar to NPN transistors, PNP's have a wedge of "N" material between two wedges of "P" material. In this design, a base current regulates the larger current flowing from emitter to collector, as indicated by the direction of the arrow on the emitter lead. In CED players, PNP transistors are used less frequently than the NPN type for amplification functions.



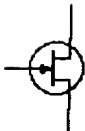
### Photo Transistor

Like the photodiode, the phototransistor is sensitive to light striking the semiconductor material through a transparent window. Photodiodes are commonly used for fast lightwave communications (as in CED infrared remote receivers), while phototransistors are typically used for optically isolated current control (such as relays that close when a light beam is broken). In F/G CED players the phototransistor is part of the OS1 Photo Coupler assembly, and cannot easily be serviced as a separate part.



### Hall Effect Latch

One of the more interesting transistor types, the Hall effect transistor's amplification is proportional to an external magnetic field. There are two HE's strategically positioned under the turntable of J/K CED players, whose output is influenced by the magnetic fields generated in the turntable motor. The output of a HE Latch is high or low depending on the position of the turntable, and the combined output of the two latches provides four possibilities corresponding to the four phases of the turntable motor. This information is sent to the mechanism microcomputer for minor speed corrections.



### N-Channel Junction Field Effect Transistor (JFET)

Field effect transistors are actually the most common type in CED players, but they are almost exclusively used within integrated circuits like the microcomputer chips. The main use of the stand-alone N-JFET is in the Pulse Interference Corrector (PIC) circuit, which prevents external microwaves in the 900 MHz range from interfering with player operation. With the N-JFET an increasing voltage on the Gate lead decreases the current allowed to flow between the Source and Drain leads.



### Unijunction Transistor (UJT)

The unijunction transistor is more like a diode than a transistor in that the voltage on the emitter (the lead with the arrow) determines whether current flows from the lower base lead (B1) to the emitter. This voltage level is called the threshold and below it the device is off. The UJT used in the pickup arm of F/G CED players functions only

at startup to lock the 915 MHz oscillator on the trailing slope of the 910 MHz tuned line response curve.



### Programmable Unijunction Transistor (PUT)

Structurally, a PUT is like a PNP transistor with the addition of a second "N" layer of silicon to form a PNPN construction. Like the UJT this is an on/off device serving as a switch rather than an amplifier. The PUT is programmable in the sense that the Gate lead (the angular one) can be set to trigger at a programmed voltage by biasing the lead with two external resistors. The PUT used in the pickup arm of J/K players replaced the UJT used in the earlier models and performs the same function.

## RCA Player Diodes:

| RCA Stock No. | Diode Type       | Package | Industry Eqv. | NTE Rep.       | TCE Rep. | ECG* Rep. | Radio Shack Rep.          | Jameco Rep. |
|---------------|------------------|---------|---------------|----------------|----------|-----------|---------------------------|-------------|
| 119597        | General Purpose  | DO-35   | 1N4009        | <u>NTE177</u>  | SK9091   | ECG177    | 276-1122                  | X           |
| 129095        | Schottky Barrier | DO-35   | 1N3011        | <u>NTE553</u>  | SK9975   | ECG553    | N/A                       | X           |
| 141829        | Zener 2.85V      | DO-41   | X             | X              | X        | X         | X                         | X           |
| 147015        | General Purpose  | DO-41   | 1N4007        | <u>NTE125</u>  | SK5010A  | ECG125    | 276-1114 /<br>RSU11928397 | 36011       |
| 147943        | Varactor         | DO-35   | 1S2209        | <u>NTE616</u>  | SK3320   | ECG616    | N/A                       | X           |
| 148056        | IR LED           | T1.75   | TLN110        | <u>NTE3027</u> | SK2027A  | ECG3027   | 276-143                   | 106526      |
| 149014        | Red LED Diffuse  | T1.75   | XC410R        | <u>NTE3020</u> | SK2020   | ECG3020   | 276-041                   | 104248      |
| 149020        | 2-Digit LED      | 16 PIN  | 935-1A23      | N/A            | N/A      | N/A       | N/A                       | X           |
| 149033        | Varactor         | DO-35   | X             | N/A            | N/A      | N/A       | N/A                       | X           |
| 149042        | Zener 9.1V       | DO-41   | 1N4739        | <u>NTE139A</u> | SK9V1    | ECG139A   | 276-562                   | 178837      |
| 150711        | IR Photo         | T1.75   | IRD500        | <u>NTE3033</u> | SK10324  | ECG3033   | 276-142                   | 112168      |
| 153342        | IR LED           | T1.75   | TLN110        | <u>NTE3027</u> | SK2027A  | ECG3027   | 276-143                   | 106526      |

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|        |                     |       |        |                |        |         |             |        |
|--------|---------------------|-------|--------|----------------|--------|---------|-------------|--------|
| 156030 | Zener<br>5.8V       | DO-41 | X      | X              | X      | X       | X           | X      |
| 157629 | Varactor            | TO-92 | X      | X              | X      | X       | X           | X      |
| 157630 | Zener<br>10V        | DO-41 | 1N4740 | <u>NTE140A</u> | SK10V  | ECG140A | RSU11928348 | 178845 |
| 157637 | Red<br>LED<br>Clear | T1.75 | XC554R | <u>NTE3025</u> | SK2025 | ECG3025 | 276-041     | 34745  |
| 159264 | General<br>Purpose  | DO-35 | 1N4009 | <u>NTE177</u>  | SK9091 | ECG177  | 276-1122    | X      |

## RCA Player Transistors:

| RCA<br>Stock<br>No. | Transistor<br>Type     | Package | Industry<br>Eqv.     | NTE Rep.        | TCE<br>Rep. | ECG*<br>Rep. | Radio Shack<br>Rep. | J<br>I |
|---------------------|------------------------|---------|----------------------|-----------------|-------------|--------------|---------------------|--------|
| 140076              | NPN Bipolar<br>Silicon | TO-92   | PN2222 /<br>MPS2222A | <u>NTE123AP</u> | SK3854      | ECG123AP     | 276-2009            | 2      |
| 140129              | NPN Bipolar<br>Silicon | TO-220  | 2SC1628              | <u>NTE188</u>   | SK3199      | ECG188       | RSU12163325         | 2      |
| 140130              | PNP Bipolar<br>Silicon | TO-220  | 2SA818               | <u>NTE189</u>   | SK3200      | ECG189       | RSU11435013         | 2      |
| 140979              | NPN Bipolar<br>Silicon | TO-220  | 2N5296 /<br>2N6122   | <u>NTE196</u>   | SK3054      | ECG196       | 276-2020            | 3      |
| 142190              | PNP Bipolar<br>Silicon | TO-92   | PN2907 /<br>MPS2907  | <u>NTE159</u>   | SK3466      | ECG159       | 276-2023            | 2      |
| 142686              | NPN Bipolar<br>Silicon | TO-92   | PN2907 /<br>MPS2907  | <u>NTE159</u>   | SK3466      | ECG159       | 276-2023            | 2      |
| 143793              | NPN Bipolar<br>Silicon | TO-92   | 2N2222               | <u>NTE123A</u>  | SK3444      | ECG123A      | 276-1617            | 3      |
| 143794              | NPN Bipolar<br>Silicon | TO-92   | PN2222 /<br>MPS2222A | <u>NTE123AP</u> | SK3854      | ECG123AP     | 276-2009            | 2      |
| 145395              | NPN Bipolar<br>Silicon | TO-92   | PN2222 /<br>MPS2222A | <u>NTE123AP</u> | SK3854      | ECG123AP     | 276-2009            | 2      |
| 145410              | PNP Bipolar<br>Silicon | TO-92   | PN2907 /<br>MPS2907  | <u>NTE159</u>   | SK3466      | ECG159       | 276-2023            | 2      |
| 145776              | PNP Bipolar<br>Silicon | TO-92   | PN2907 /<br>MPS2907  | <u>NTE159</u>   | SK3466      | ECG159       | 276-2023            | 2      |

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|        |                          |        |                   |                 |         |          |             |   |
|--------|--------------------------|--------|-------------------|-----------------|---------|----------|-------------|---|
| 146847 | NPN Bipolar Silicon      | TO-92  | PN2222 / MPS2222A | <u>NTE123AP</u> | SK3854  | ECG123AP | 276-2009    | 2 |
| 148061 | NPN Bipolar Silicon      | TO-92  | PN2222 / MPS2222A | <u>NTE123AP</u> | SK3854  | ECG123AP | 276-2009    | 2 |
| 148070 | N-Channel JFET           | TO-92  | 2SK161Y           | <u>NTE451</u>   | SK9164  | ECG451   | 276-2062    | 2 |
| 148996 | NPN Bipolar Silicon      | TO-92  | PN2222 / MPS2222A | <u>NTE123AP</u> | SK3854  | ECG123AP | 276-2009    | 2 |
| 149007 | Unijunction Silicon      | TO-92  | 2N4870            | <u>NTE6410</u>  | SK9121  | ECG6410  | N/A         | 2 |
| 149040 | PNP Bipolar Silicon      | TO-92  | PN2907 / MPS2907  | <u>NTE159</u>   | SK3466  | ECG159   | 276-2023    | 2 |
| 149041 | PNP Bipolar Silicon      | TO-92  | PN2907 / MPS2907  | <u>NTE159</u>   | SK3466  | ECG159   | 276-2023    | 2 |
| 150247 | N-Channel JFET           | TO-92  | 2SK161Y           | <u>NTE451</u>   | SK9164  | ECG451   | 276-2062    | 2 |
| 151326 | NPN Bipolar Silicon      | TO-92  | 2N4401 / PN4401   | <u>NTE229</u>   | SK3246A | ECG229   | 276-2058    | 3 |
| 153343 | NPN Bipolar Silicon      | TO-92  | PN2222 / MPS2222A | <u>NTE123AP</u> | SK3854  | ECG123AP | 276-2009    | 2 |
| 155882 | PNP Bipolar Silicon      | TO-220 | 2SA699A           | <u>NTE197</u>   | SK3083  | ECG187   | 276-2027    | 3 |
| 156262 | Programmable Unijunction | TO-92  | 2N6027            | <u>NTE6402</u>  | SK3628  | ECG6402  | N/A         | 2 |
| 157631 | NPN Bipolar Silicon      | TO-92  | PN2222 / MPS2222A | <u>NTE123AP</u> | SK3854  | ECG123AP | 276-2009    | 2 |
| 157632 | NPN Bipolar Silicon      | TO-92  | 2N2222            | <u>NTE123A</u>  | SK3444  | ECG123A  | 276-1617    | 2 |
| 157638 | Hall Effect Latch        | SIP-3  | <u>UGN3175U</u>   | X               | X       | X        | RSU12035663 | 2 |
| 157808 | PNP Bipolar Silicon      | TO-92  | PN2907 / MPS2907  | <u>NTE159</u>   | SK3466  | ECG159   | 276-2023    | 2 |
| 158289 | NPN Bipolar Silicon      | TO-220 | 2SC1628           | <u>NTE188</u>   | SK3199  | ECG188   | RSU12163325 | 2 |
| 159299 | NPN Bipolar Silicon      | TO-92  | PN2907 / MPS2907  | <u>NTE159</u>   | SK3466  | ECG159   | 276-2023    | 2 |
| 159300 | PNP Bipolar Silicon      | TO-92  | PN2907 / MPS2907  | <u>NTE159</u>   | SK3466  | ECG159   | 276-2023    | 2 |
| 160694 | NPN Bipolar Silicon      | TO-92  | 2N2222            | <u>NTE123A</u>  | SK3444  | ECG123A  | 276-1617    | 3 |

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\* On January 19, 2001 NTE purchased ECG. I'm leaving the ECG replacements in the table, since with ECG having been around for so long, new old stock with ECG numbers will continue turning up for some time.

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